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The International Bureau of WIPO
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Re: International Application No. PCT/US98/19564
Entitled: ***"Improved Sample Inspection System"***
Applicant: KLA-TENCOR CORPORATION
International Filing Date: 18 September 1998
Our File: TNCR.152WO0

Dear Sir/Madam:

Pursuant to Article 19(1) and Rule 46.1, Applicant submits the enclosed replacement sheets (pages 28-39 to replace original pages 28-45) to amend the claims in the above-referenced Application. This letter is written in accordance with PCT Rule 66.8 and serves to point out the differences between the replaced sheets and the replacement sheets.

IN THE CLAIMS:

Claim 1:	This claim replaces claim 1 as originally filed.
Claims 2-19:	These claims remain unchanged.
Claim 20:	This claim replaces claim 20 as originally filed.
Claim 21:	This claim remains unchanged.
Claim 22:	This claim replaces claim 22 as originally filed.
Claim 23:	This claim replaces claim 23 as originally filed.
Claim 24:	This claim remains unchanged.
Claim 25:	This claim remains unchanged.
Claims 26-37:	These claims are cancelled.
Claim 38:	This claim replaces claim 38 as originally filed.
Claims 39-53:	These claims remain unchanged.
Claim 54:	This claim replaces claim 54 as originally filed.
Claim 55:	This claim remains unchanged.
Claim 56:	This claim replaces claim 56 as originally filed.
Claim 57:	This claim replaces claim 57 as originally filed.
Claims 59-84:	These claims are cancelled.
Claim 85:	This claim replaces claim 85 as originally filed.

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Claim 86-88:	These claims replace claims 86-88 as originally filed.
Claims 89-92:	These are new claims.

Sincerely,

MAJESTIC, PARSONS, SIEBERT & HSUE P.C.

James S. Hsue

/lt
Atts.

cc: IPEA/US -- via facsimile (703/305-3230)

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WHAT IS CLAIMED IS:

1. An optical system for detecting anomalies of a sample, comprising:

first means for directing a first beam of radiation along a first path onto a surface of the sample;

second means for directing a second beam of radiation along a second path onto a surface of the sample;

a first detector; and

means including a mirrored surface for receiving scattered radiation from the sample surface and originating from the first and second beams and for focusing the scattered radiation to said first detector.

2. The system of claim 1, wherein said mirrored surface is a curved surface and has an axis of symmetry substantially coaxial with the first path, defining an input aperture positioned proximate to the sample surface to receive scattered radiation therethrough from the sample surface.

3. The system of claim 2, said mirrored surface being a paraboloidal mirrored surface, the mirrored surface reflecting radiation that passes through the input aperture, said receiving and focusing means further including means for focusing radiation reflected by the mirrored surface to the first detector.

4. The system of claim 2, said mirrored surface being an ellipsoidal mirrored surface, the mirrored surface reflecting and focusing radiation that passes through the input aperture.

5. The system of claim 1, said first path being not more than about 10° angle from a normal direction to the sample surface.

6. The system of claim 5, said first path being substantially normal to the sample surface.

7. The system of claim 5, said second path being at an angle within a range of about 45 to 85 degrees to a normal direction to the sample surface.

8. The system of claim 1, said first and second beams producing a first and a second illuminated spot on the sample surface, said first and second illuminated spots substantially coinciding.

9. The system of claim 1, said first and second beams producing a first and a second illuminated spot on the sample surface, said first and second illuminated spots separated by an offset.

10. The system of claim 9, said first or second beam having a point spread function with a spatial extent, wherein said offset is not less than said spatial extent but not greater than three times the spatial extent.

11. The system of claim 1, said first and second means comprising:

a source supplying a radiation beam; and

means for converting the radiation beam supplied by the source into said first and second beams.

12. The system of claim 11, said source supplying radiation of at least a first and a second wavelength, wherein said first detector detects radiation of the

first wavelength, said system further comprising a second detector for detecting radiation of the second wavelength.

13. The system of claim 11, said converting means including a switch that causes the radiation beam from the source to be transmitted alternately along the two paths towards the sample surface.

14. The system of claim 13, said system further comprising means for acquiring data from the detector at a data rate, said switch operating at a frequency of at least about three times that of the data rate.

15. The system of claim 13, said system further comprising means for acquiring data from the detector at a data rate, said switch operating at a frequency of at least about five times that of the data rate.

16. The system of claim 13, said switch including an electro-optic modulator or Bragg modulator.

17. The system of claim 1, the sample having a smooth surface, wherein the second path is at an oblique angle to the sample surface, and the second beam is P or S polarized with respect to the sample surface.

18. The system of claim 1, the sample having a rough surface, wherein the second path is at an oblique angle to the sample surface, and the second beam is S polarized with respect to the sample surface.

19. The system of claim 1, further comprising means for comparing detected scattered radiation originating from the first beam and that originating

from the second beam to distinguish between particles and COPs.

20. An optical system for detecting anomalies of a sample, comprising:

first means for directing a first beam of radiation along a first path onto a surface of the sample;

second means for directing a second beam of radiation along a second path onto a surface of the sample, said first and second beams producing a first and a second illuminated spot on the sample surface, said first and second illuminated spots separated by an offset;

a detector; and

means for receiving scattered radiation from the first and second illuminated spots and for focusing the scattered radiation to said detector.

21. The system of claim 20, said first or second beam having a point spread function with a spatial extent, wherein said offset is not less than said spatial extent but not greater than three times the spatial extent.

22. An optical system for detecting anomalies of a sample, comprising:

a source supplying a beam of radiation at at least a first and a second wavelength; and

means for converting the radiation beam supplied by the source into a first beam at a first wavelength along a first path and a second beam at a second wavelength along a second path onto a surface of the sample;

a first detector detecting radiation at the first wavelength and a second detector detecting radiation at the second wavelength; and

means for receiving scattered radiation from the sample surface and originating from the first and second beams and for focusing the scattered radiation to said detectors.

23. An optical system for detecting anomalies of a sample, comprising:

a source supplying a radiation beam;

a switch that causes the radiation beam from the source to be transmitted towards the sample surface alternately along a first and a second path;

a detector;

means for receiving scattered radiation from the sample surface and originating from the beam along the first and second paths and for focusing the scattered radiation to said detector.

24. The system of claim 23, said system further comprising means for acquiring data from the detector at a data rate, said switch operating at a frequency of at least about three times that of the data rate.

25. The system of claim 23, said switch including an electro-optic modulator or Bragg modulator.

26. An optical system for detecting anomalies of a sample, comprising:

means for directing at least one beam of radiation along a path onto a spot on a surface of the sample;

a first detector;

means for receiving scattered radiation from the sample surface and originating from the at least one beam and for focusing the scattered radiation to said first detector for sensing anomalies;

a second, position sensitive, detector detecting a specular reflection of said at least one beam in order

to detect any change in height of the surface at the spot; and

means for altering the path of the at least one beam in response to the detected change in height of the surface at the spot to reduce position error of the spot caused by change in height of the surface at the spot.

27. The system of claim 26, said directing means including a mirror, said altering means including means for rotating the mirror.

28. The system of claim 27, said directing means including three lenses focusing a beam from the mirror to the sample surface.

29. The system of claim 26, said second detector providing a position signal indicating height of the sample surface at the spot, said altering means including:

means for providing a control signal having an amplitude equal to about half that of the position signal; and

a transducer rotating the mirror by an amount proportional to the amplitude of the control signal.

30. The system of claim 29, said providing means including a controller.

31. The system of claim 27, said directing means including a lens focusing a beam from the mirror to the sample surface.

32. An optical system for detecting anomalies of a sample, comprising:

means for directing at least one beam of radiation along a path onto a spot on a surface of the sample;

a first detector;

means for collecting scattered radiation from the sample surface and originating from the at least one beam and for conveying the scattered radiation to said first detector for sensing anomalies; and

a spatial filter between the first detector and the collecting and conveying means blocking scattered radiation towards the detector except for at least one area having a wedge shape.

33. The system of claim 32, said filter having a shape of a butterfly with two wings, wherein scattered radiation towards the detector is blocked by the two wings and passes between the wings.

34. The system of claim 32, wherein said filter is programmable to alter the size, position or orientation of the at least one area.

35. The system of claim 34, said wedge shape having a wedge angle, said filter comprising:

an array of wedge-shaped electrodes arranged around a center, each electrode in the array overlapping at least one additional electrode;

a layer of liquid crystal material between the array and said at least one additional electrode; and

means for applying electrical potentials across one or more electrodes in the array and the at least one additional electrode to control radiation transmission through sections of the liquid crystal layer to alter the size, position or orientation of the at least one area.

36. The system of claim 35, said wedge-shape electrodes having wedge angle(s) that are at least about 5 degrees.

37. The system of claim 32, said directing means directing said at least one beam of radiation along a path at an oblique angle to the sample surface.

38. An optical method for detecting anomalies of a sample, comprising:

directing a first beam of radiation along a first path onto a surface of the sample;

directing a second beam of radiation along a second path onto a surface of the sample; and

employing a mirrored surface for receiving scattered radiation from the sample surface and originating from the first and second beams and focusing the scattered radiation to a first detector.

39. The method of claim 38, said first path being not more than about 10° angle from a normal direction to the sample surface.

40. The method of claim 38, said first path being substantially normal to the sample surface.

41. The method of claim 38, said second path being at an angle within a range of about 45 to 85 degrees to a normal direction to the sample surface.

42. The method of claim 38, said first and second beams producing a first and a second illuminated spot on the sample surface, said first and second illuminated spots substantially coinciding.

43. The method of claim 38, said first and second beams producing a first and a second illuminated spot on the sample surface, said first and second illuminated spots separated by an offset.

44. The method of claim 43, said first or second beam having a point spread function with a spatial extent, wherein said offset is not less than said spatial extent but not greater than three times the spatial extent.

45. The method of claim 38, said first and second beam directing comprising:

providing a source supplying a radiation beam; and

converting the radiation beam supplied by the source into said first and second beams.

46. The method of claim 45, said source supplying radiation of a first and a second wavelength, wherein said first detector detects radiation of the first wavelength, said method further comprising detecting radiation of the second wavelength by means of a second detector.

47. The method of claim 45, said converting including switching the radiation beam from the source alternately between the two paths towards the sample surface.

48. The method of claim 47, said method further comprising acquiring data from the first detector at a data rate, wherein said switching is at a frequency of at least about three times that of the data rate.

49. The method of claim 47, said method further comprising acquiring data from the first detector at a data rate, wherein said switching is at a frequency of at least about five times that of the data rate.

50. The method of claim 38, the sample having a smooth surface, wherein the second path is at an oblique

angle to the sample surface, and the directing directs a second beam that is S or P polarized with respect to the sample surface.

51. The method of claim 38, the sample having a rough surface, wherein the second path is at an oblique angle to the sample surface, and the directing directs a second beam that is S polarized with respect to the sample surface.

52. The method of claim 38, further comprising scanning sequentially the first and second beams across the same portion of the sample surface, wherein the first but not the second beam is directed to said surface while it is being scanned in a cycle, and the second but not the first beam is directed to said surface while it is being scanned in a subsequent cycle.

53. The method of claim 38, further comprising comparing detected scattered radiation originating from the first beam and that originating from the second beam to distinguish between particles and COPs.

54. An optical method for detecting anomalies of a sample, comprising:

directing a first beam of radiation along a first path onto a surface of the sample;

directing a second beam of radiation along a second path onto a surface of the sample, said first and second beams producing a first and a second illuminated spot on the sample surface, said first and second illuminated spots separated by an offset; and

receiving scattered radiation from the first and second illuminated spots and focusing the scattered radiation to a detector.

55. The method of claim 54, said first or second beam having a point spread function with a spatial extent, wherein said offset is not less than said spatial extent but not greater than three times the spatial extent.

56. An optical method for detecting anomalies of a sample, comprising:

supplying a beam of radiation at at least a first and a second wavelength;

converting the radiation beam into a first beam at a first wavelength along a first path and a second beam at a second wavelength along a second path, said two beams directed onto a surface of the sample;

detecting radiation at the first and second wavelengths by means of one or more detectors; and

receiving scattered radiation from the sample surface and originating from the first and second beams and focusing the scattered radiation to said detectors.

57. An optical method for detecting anomalies of a sample, comprising:

supplying a radiation beam;

switching alternately the radiation beam between a first and a second path towards a surface of the sample; and

receiving scattered radiation from the sample surface and originating from the beam along the first and second paths and focusing the scattered radiation to a detector.

58. The method of claim 57, said method further comprising acquiring data from the detector at a data rate, wherein said switching is at a frequency of at least about three times that of the data rate.

59. An optical method for detecting anomalies of a sample, comprising:

directing at least one beam of radiation along a path onto a spot on a surface of the sample;

receiving scattered radiation from the sample surface and originating from the at least one beam and focusing the scattered radiation to a first detector for sensing anomalies;

detecting a specular reflection of said at least one beam in order to detect any change in height of the surface at the spot; and

altering the path of the at least one beam in response to the detected change in height of the surface at the spot to reduce position error of the spot caused by change in height of the surface at the spot.

60. The method of claim 59, said directing including reflecting a beam of radiation from a mirror, wherein said altering includes rotating the mirror.

61. The system of claim 59, said specular reflection detection providing a position signal indicating height of the sample surface at the spot, said altering including:

providing a control signal having an amplitude equal to about half that of the position signal; and

rotating the mirror by an amount proportional to the amplitude of the control signal.

62. An optical method for detecting anomalies of a sample, comprising:

directing at least one beam of radiation along a path onto a spot on a surface of the sample;

collecting scattered radiation from the sample surface and originating from the at least one beam and

conveying the scattered radiation to a first detector for sensing anomalies; and

blocking scattered radiation towards the detector except for at least one area having a wedge shape.

63. The method of claim 62, said at least one area having a shape of a butterfly with two wings, wherein scattered radiation towards the detector is blocked at the two wings and passes between the wings.

64. The method of claim 62, further comprising altering the size of the at least one area.

65. The method of claim 64, said wedge shape having a wedge angle, said method employing an array of wedge-shaped electrodes arranged around a center, each electrode in the array overlapping at least one additional electrode, and a layer of liquid crystal material between the array and said at least one additional electrode; said altering including:

applying electrical potentials across one or more electrodes in the array and the at least one additional electrode to control radiation transmission through sections of the liquid crystal layer to alter the wedge angle.

66. The method of claim 65, said wedge-shaped electrodes having wedge angle(s) that are at least about 5 degrees.

67. The method of claim 62, wherein said directing directs said at least one beam of radiation along a path at an oblique angle to the sample surface.

68. An optical system for detecting anomalies of a sample, comprising:

means for directing a beam of radiation along a path at an oblique angle onto a surface of the sample;

a detector; and

means including a curved mirrored surface for receiving scattered radiation from the sample surface and originating from the beam and for focusing the scattered radiation to said detector.

69. The system of claim 68, wherein said mirrored surface has an axis of symmetry substantially coaxial with the path, defining an input aperture positioned proximate to the sample surface to receive scattered radiation therethrough from the sample surface.

70. The system of claim 69, said mirrored surface being a paraboloidal mirrored surface, the mirrored surface reflecting radiation that passes through the input aperture, said receiving and focusing means further including means for focusing radiation reflected by the mirrored surface to the first detector.

71. The system of claim 69, said mirrored surface being an ellipsoidal mirrored surface, the mirrored surface reflecting and focusing radiation that passes through the input aperture.

72. The system of claim 68, said path being at an angle within a range of about 45 to 85 degrees to a normal direction to the sample surface.

73. The system of claim 68, further comprising a spatial filter between the detector and the mirrored surface, said filter blocking scattered radiation towards the detector except for at least one area having a wedge shape.

74. The system of claim 73, said filter having a shape of a butterfly with two wings, wherein scattered radiation towards the detector is blocked by the two wings and passes between the wings.

75. The system of claim 73, wherein said filter is programmable to alter the size, position or orientation of the at least one area.

76. The system of claim 75, said wedge shape having a wedge angle, said filter comprising:

an array of wedge-shaped electrodes arranged around a center, each electrode in the array overlapping at least one additional electrode;

a layer of liquid crystal material between the array and said at least one additional electrode; and

means for applying electrical potentials across one or more electrodes in the array and the at least one additional electrode to control radiation transmission through sections of the liquid crystal layer to alter the wedge angle.

77. The system of claim 76, said wedge-shaped electrodes having wedge angle(s) that are at least about 5 degrees.

78. An optical method for detecting anomalies of a sample, comprising:

directing a beam of radiation along a path at an oblique angle onto a surface of the sample;

providing a curved mirrored surface to receive scattered radiation from the sample surface and originating from the beam; and

detecting the scattered radiation from the mirrored surface to detect anomalies of the sample.

79. The method of claim 78, further including focusing radiation reflected by the mirrored surface to a detector.

80. The method of claim 78, said path being at an angle within a range of about 45 to 85 degrees to a normal direction to the sample surface.

81. The method of claim 78, further comprising blocking scattered radiation towards the detector except for at least one area having a wedge shape.

82. The method of claim 81, wherein the blocking blocks scattered radiation towards the detector over an area in the shape of a butterfly with two wings and passes scattered radiation towards the detector between the wings.

83. The method of claim 81, further comprising changing the size of the at least one area.

84. The method of claim 83, said wedge shape having a wedge angle, said blocking employing a filter comprising an array of wedge-shaped electrodes arranged around a center, each electrode in the array overlapping at least one additional electrode and a layer of liquid crystal material between the array and said at least one additional electrode; said changing including:

applying electrical potentials across one or more electrodes in the array and the at least one additional electrode to control radiation transmission through sections of the liquid crystal layer to alter the wedge angle.

85. An optical system for detecting anomalies of a sample, comprising:

means for directing a beam of radiation along a first path at an oblique angle of incidence onto a surface of the sample;

detecting means including at least two detectors, said at least two detectors comprising a first detector located to detect light scattered by the surface within a first range of collection angles from a normal direction to the surface and a second detector located to detect light scattered by the surface within a second range of collection angles from the normal direction, said second range being different from the first range; and

means for comparing outputs of the two detectors to distinguish between a particle and a COP on the surface.

86. The system of claim 85, wherein the collection angles of said first range are smaller than the collection angles of said second range, said first detector including at least one lens for collecting light to be detected, said second detector including a mirrored surface for receiving scattered radiation from the sample surface.

87. The system of claim 86, said mirrored surface being substantially ellipsoidal or paraboloidal in shape.

88. A method for detecting anomalies of a sample, comprising:

directing a beam of radiation along a first path at an oblique angle of incidence onto a surface of the sample;

detecting light scattered by the surface within a first and a second range of collection angles from a normal direction to the surface, said second range being different from the first range; and

comparing outputs of the two detectors to distinguish between a particle and a COP on the surface.